A Study of Volatility of Crude oil Prices for Oil Price prediction – Indian Scenario

SYNOPSIS

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Introduction:

The spontaneous formation of crude oil from hydrocarbon reserves and other organic molecules results in the formation of crude oil. Petroleum, in its crude form, is an old- fashioned energy sources that may be processed further to produce gasoline, diesel, and other valuable products. petrochemicals. It is a limited resource since it is non-renewable and will eventually run out. diminish at the rate of its consumption. Crude oil is a complex combination of several substances. Depending on the oil field, the appearance and content of organic molecules vary. According to its composition, crude oil is categorised as paraffinic, naphthenic, aromatic, or asphaltic. Number of molecules in the hydrocarbon series present, which controls the physical and chemical properties properties. Although there are a variety of theories on the origins of crude oil, the prevalent theory is.

The bulk of deposits are the consequence of the burial and transformation of organic matter, according to agreement. Roughly 200 million years ago on geological timeframes Consequently, the entire clearly, the amount of oil and gas contained in the earth's subsurface is limited. Although some of these assets have not yet been identified, the overall quantity of "undiscovered resources "is not known.

The US Geological Survey 2000, 2007, and 2009 reports, as well as the International Energy Agency (IEA) 2004 estimates of total crude oil production are the most frequently

acknowledged. reserves in the subsurface of the planet. There is no internationally accepted definition of conventional oil against unconventional gas. Non-standard hydrocarbons are

defined as products that need considerably different manufacturing technique than others sources presently under study. Frequently, crude oil is extracted by drilling. Frequently found along with other resources such as natural gas (which is lighter than oil) crude oil (which thus lies above it) and salt water (which is denser and sinks below). Crude Various consumer goods, including gasoline, are created by refining and processing oil, kerosene, and asphalt.

Despite being called "black gold," crude oil is available in a range of viscosities and hues, from black to yellow, depending on its hydrocarbon concentration. The first step in refining is distillation, which involves heating oil and separating its elements. Coal and other fossil fuels had been extracted for millennia, but crude oil was found and exploited during the Industrial Revolution, and industrial uses started in the nineteenth century. The newly developed machines affected how people worked, and their functioning was dependent on these resources. The global economy has grown more dependent on fossil fuels such as crude oil, and the demand for these resources often leads to political instability since just a few of nations hold the largest reserves. Similar to other industries, crude oil price and profitability are largely determined by supply and demand. The United States, Saudi Arabia, and Russia are the three largest oil producers in the world.

Prices plummeted from $2.56 per barrel in 1876 to $0.56 per barrel in 1892 as U.S. and Russian production increased. The introduction of the first commercial automobiles in Germany and the United States in 1896, however, heralded the beginning of a technical revolution that would soon lead to a rise in the global need for oil.

Numerous of the world's most notable petroleum corporations may be traced back to the subsequent decade.

Near 1901, Gulf Oil and Texaco were created as a result of the oil discovery in Spindletop, Texas.

- Royal Dutch and Shell merged in 1907 to become Royal Dutch/Shell in response to increased price competition from U.S. companies.

- The Anglo-Persian Oil Company (now BP) was founded in 1908, after the discovery of oil in Iran.
- Chevron, Exxon, and Mobil (now Exxon Mobil) were founded in 1911 when the U.S. Supreme Court divided Standard Oil due to antitrust violations.

- At the height of their influence in the early 1970s, these multinational oil companies (IOCs)

— BP, Chevron, Exxon, Gu

lf Oil, Mobil, Royal Dutch/Shell, and Texaco — controlled 85 percent of the world's oil reserves, earning them the nickname “seven sisters”.

Crude oil Production in India:

(Source: Annual report 2019-20 Ministry of Petroleum and Natural gas GOI)

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Statement of Problem:

The economy of a nation is defined by its income and expenditures, which are gathered via several avenues. It is categorized largely as Tax and Non-Tax revenues.

In addition, the economy is reliant on macroeconomic indicators such as the foreign exchange market, gold prices, stock market indices, gross domestic product, and crude oil prices. These variables are all statistically significant and positively correlated with one another. The research seeks to establish a linear link between these factors and also develops univariate and multivariate models to estimate crude oil prices in order to reduce future price volatility.

Forecasting crude oil permits the prediction of future price fluctuations, allowing enterprises reliant on crude oil, commodities speculators, and investors to hedge their risk correctly and estimate future prices. Crude oil is essential to the economic viability of any nation.

It has a significant impact on the majority of macroeconomic indicators of the nation. This research will help us determine the long- and short-term implications of crude oil prices on

economic indices including the US dollar exchange rate, gold prices, the NIFTY, the SENSEX, and the nation's gross domestic product.

The forecasting of crude oil prices will include both univariate and multivariate time series analysis. Using these methods, the research investigates the impact of crude oil prices on the previously indicated factors.

Objectives on the basis of the research:

- To examine how different economic factors affect the cost of crude oil.

- To research the impact and causality of crude oil's price on GDP.

- To assess how the strength of the dollar affects the cost of crude oil.

- To calculate how gold price fluctuations can affect the cost of crude oil. • To determine how the SENSEX affects the cost of crude oil.

- To determine how the NIFTY index affects crude oil prices.

- To attempting to predict how the price of crude oil will evolve in the future.
- To examine how predicting crude oil prices affects India's economy study.

Hypothesis:

The following hypothesis has been developed considering the objectives.

Hypothesis 1:

H01: Neither the US dollar to Indian rupee exchange rate nor crude oil prices exhibit a linear connection.

Ha1: crude oil prices are linearly related to the US dollar exchange rate.

Hypothesis 2:

H02: there is no linear relationship between Gold prices and crude oil prices Ha2: there is a linear relationship between Gold prices and crude oil prices

Hypothesis 3:

H03: there is no linear relationship between NIFTY and crude oil prices Ha3: there is a linear relationship between NIFTY and crude oil prices

Hypothesis 4:

H04: there is no linear relationship between Sensex and crude oil prices Ha4: there is a linear relationship between Sensex and crude oil prices

Hypothesis 5:

H05: there is no linear relationship between GDP and crude oil prices Ha5: there is a linear relationship between GDP and crude oil prices

Hypothesis 6:

H06: There is no Univariate effect of Crude oil Prices Ha6: There is a Univariate effect of Crude oil Prices

Hypothesis 7:

H07: There is no Cointegration of economic indicators on Crude oil Prices Ha7: There is a Cointegration of economic indicators on Crude oil Prices

Hypothesis 8:

H07: There is no Granger Causality of economic indicators on Crude oil Prices Ha7: There is a Granger Causality of economic indicators on Crude oil Prices

Research gap:

Based on the findings of the reviewed literature, it is evident that fluctuations or price shocks in the price of crude oil have an impact on a country's macroeconomic indicators.

Leptokurtic, large-tailed, and nonlinear conditional volatility are all common in the distributions of financial time series. With this quality, conventional models like the ARCH and GARCH lose some of their predictive ability (Bildirici, Melike).

There is some evidence from studies of the relationship between the price of crude oil and the price of an Indian crude oil basket. Very little work has been done to identify the global factors influencing swings in the Indian basket crude oil price. To rephrase, the worldwide crude oil price benchmark set by the Indian basket has not received as much attention as other such indices throughout the world. This article's objective is to analyse the factors that impact the Indian basket price of crude oil. Therefore, it provides new insight into this field of research. (Sarkar, Bidisha).

Currency and global stock returns have weaker time-varying coefficients compared to the statistically significant dynamic correlations between oil WTI and currencies. "(Varella, André)

When comparing the CCC model with asymmetry to the ARMA-DCC-GARCH model, the latter is superior in its ability to estimate correlations that fluctuate over time. The study also compares the pros and cons of hedging your portfolio using a mix of stock futures and energy commodities futures trading in pairs. Portfolio investors who engage in futures trading on the Indian stock market and energy commodities may use these findings in a number of ways, including to better evaluate their exposure to market risk and to determine whether or not diversification benefits their holdings. (Satish Kumar) The price of crude oil is sensitive to changes in a number of other markets, including the gold price, the USD/INR exchange rate, GDP, the SENSEX, and the NIFTY.

While earlier research has looked at the influence of crude oil prices on a single or two variables (economic indicators) using either Univariate or Multivariate analysis, the current investigation employs both methods to examine the relationship between significant macroeconomic indicators and crude oil prices over the short and long term.

Thus assisting the investigation into the extent to which economic indicators may be used to anticipate changes in crude oil prices.

Sample size:

The prediction of crude oil prices and the influence of economic factors on such predictions will be the subject of extensive research from April 2000 to March 2021. In this part, we will

examine the impact that various economic factors have on the price of crude oil. Prices for crude oil are calculated before any applicable state taxes are deducted. Since the gathered information is time-sensitive, it is vulnerable to environmental influences. When converting nonstationary data to stationary data, the difference or log difference at the outset of the data collection was taken into account. Data from 2000-2020 is used for analysis, but data beginning in April 2020 and beyond is what is used to ensure reliability in future projections.

Statistical tools used:

The research relies on secondary data, thus it is crucial that it has reliable information; for this reason, we will only gather information from trusted and legitimate sources. Given the nature of secondary data, no effort was made to clean the data before using it; rather, the data were used in their raw form to meet the needs of the research.

To determine the central tendency, dispersion, and variability of the data, we will also analyse some more summary statistics.

In the future, we will use the ordinary least squares test to show that the variables are linearly related and that the residual arch effect follows a normal distribution. The unit root test will also be used in this investigation.

The ARIMA test and model will also be applied to the data for univariate analysis, and the ARIMA model will be used for the forecasting purposes.

Next, we'll utilise multivariate analysis to look at how different economic indices correlate with crude oil costs. To determine the immediate effect of economic indicators on crude oil prices and to probe the nature of the long-term link between economic indicators and crude oil prices, co-integration experiments will be conducted. Forecasts of crude oil prices beyond March 2022 will be made using a vector auto regression test and a VAR model.

The research will be conducted using Gretl software when it has been determined that the data is fit for further analysis. In addition to using a univariate analysis, we will also conduct a multivariate analysis (using ARIMA, Cointegration, and Vector Auto Regression) to forecast crude oil prices.

Conclusion of the study:

The purpose of this research was to evaluate the reliability of Crude oil price projections using a number of statistical techniques in order to provide guidance to the different parties involved.

The research establishes correlations between crude oil prices and other macroeconomic indicators including the US dollar exchange rate, gold prices, the Sensex, the NIFTY, and the GDP. It was expected that this investigation would find a linear connection between economic indicators and crude oil prices, and that hypothesis was confirmed. When the linear relationship was established, more research was done to provide a univariate analysis of crude oil prices. Researchers examined different univariate models and settled on the ARIMA model as providing the best fit for the data, despite the fact that the ARCH effect could be calculated.

Like the ARIMA model, the ARMA model's univariate study and price forecasting have both shown improved performance when integration is set to zero. During the same time period of analysis, ARCH and GARCH were also utilised; however, despite the study's capacity to show significance, the GARCH/ARCH prediction of prices had a larger standard error than ARMA. ARCH/GARCH were not investigated since the study's focus was on improving existing methods of prediction rather than developing new ones.

Although ARMA proved successful in predicting the price of crude oil, qualitative effects of data that might be collected using those data but would have an equivalent impact owing to qualitative news were not taken into account, leading to additional white noise in the analysis. As a result, research into multivariate methods was conducted as well.

Quantile regression, Vector auto regression, Engle granger cointegration, and the Vector Error correction model of cointegration were explored in multivariate analysis to identify the short- and long-term effects of factors on Crude oil prices. So, the study will look at the likelihood of projecting Crude oil prices and the researcher will collect all the data necessary for making such a prediction.

Publications in Scopus / UGC-Care List

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Sr.no.	Title of Paper	Name of Journal	ISSN Number	Publisher	Volume & Issue	Month/ Year	Page nos. in Journal	URL	Included in which List (Scopus/ UGC-Care)?*	Remarks (if applicable)
1	ANALYSIS OF THE DYNAMICS OF CRUDE OIL PRICES IN RELATION TOTHE DOLLAR AND GOLD PRICES– INDIAN PERSPECTIVE.	Annals of Forest Research	ISSN:1844-8135 E-ISSN:2065-2445	Forest Research and Management Institute	VOL 65, NO 1 (2022)	Nov(2022)	4421-4430	https://www.e-afr.org/article/view/4421.html	https://www.scopus.com/sourceid/19600161803	
2	A STUDY ON EFFECTS OF MACRO ECONOMIC INDICATORS ON CRUDE OIL PRICES – PHASE TOWARDS BUILDING STRONG MODEL FOR CRUDE OIL PRICE PREDICTION.	Vegueta	eISSN: 2341-1112	University of Las Palmas deGran Canaria, Faculty of Geography and History	Volume: 22 Issue: 11, November 2022	Nov(2022)	127-133	https://vegueta.org/current.html	https://www.scopus.com/sourceid/21101039668	

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